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Description

Background of the Invention

Field of the Invention

The present invention relates to an improved cylinder block construction according to the preamble part of claim which both improves the structural rigidity and cooling efficiency thereof. Such a cylinder block is known from EP—A—0048020.

Description of the Prior Art

In a conventional liquid cooled multi cylinder internal combustion engine cylinder block such as shown in Fig. 1 of the drawings, a suitable coolant such as water is forcefully circulated through the cylinder block 1, cooled in an air cooled heat exchanger or radiator (not shown) and recirculated back into the cylinder block 1. However, in such arrangements it is necessary, in order to achieve uniform cooling of the cylinders 2, to provide free fluid flow within the coolant jacket both between and around same. This induces a problem that the reinforcing interconnections between the cylinders 2 (which are cylindrical and structurally rigid) and the outer wall 3 of the cylinder block (which is flat and relatively flexible) are limited whereby the structural rigidity of the outer wall of the cylinder block tends to be inadequate. Accordingly, the wall tends to vibrate, especially under given modes of engine operation, and thus define a source of noise.

In order to overcome this problem US—A—4 343 267 describes a cylinder block with ribs to provide a partial connection between the cylinders and the outer wall. However, excessive use of same obstructs coolant flow undesirably. Further, the shape and location of the ribs is severely limited due to the internal flow requirement mentioned above. Accordingly, an engine block having an coolant jacket wall featuring a suitable level of rigidity has been difficult to obtain especially while maintaining the weight of same at a suitably low level.

More recently, a radically different type of engine cooling system such as shown in Fig. 2 of the drawings has been proposed. This system is disclosed in EP—A—0 059 423, published on September 8, 1982. This system basically features an arrangement wherein the coolant in the coolant jacket 4 defined in the cylinder block 5, is permitted to boil and the gaseous and/or boiling coolant passed through the cylinder head 6 to a compressor 7. The compressor 7 compresses the gaseous coolant raising the temperature and pressure thereof and pumps same into an air cooled heat exchanger (radiator) 8. Due to the high temperature differential between the atmosphere and the high temperature-pressure vapour, the cooling efficiency of this arrangement is remarkably high. Subsequent to condensation the coolant is recirculated back into the cylinder block by way of a reservoir 9 (including a liquid level sensor 10) and an expansion valve 11.

Summary of the Invention

Finally, FR—A—1,088,475 discloses a cylinder block which is also intended for use with a circulation-type cooling system but not for an evaporative cooling system. Moreover, the ribs of this known cylinder block are adapted to separate the space between an inner cylinder and an outer cylinder into four chambers being connected to each other by a plurality of openings. With this construction, an improved cooling efficiency shall be achieved by the fact that a part of the coolant which is already heated to a certain degree is mixed with another part of coolant still being remarkably cooler in order to keep the temperature of the coolant within a desirable range.

Thus, the cylinder blocks known from US—A—4,343,267 and FR—A—1,088,475 are intended for accelerating the coolant fluid in order to improve cooling.

The present invention is based on the realization that, with the advent of the above mentioned type of cooling system it was no longer detremental to stagnate the flow of coolant within the cylinder block and even advantageous to do so. Hence, the present invention features a cylinder block of the nature utilized in the above mentioned system, which includes reinforcing ribbing in the coolant jacket which ribbing simultaneously provides the long desired coolant jacket outer wall rigidity and increases the surface area via which the heat from the cylinders may be transferred to which the coolant.

Accordingly, it is the object of the present invention to provide a unique cylinder block according to the preamble part of claim 1 wherein both high cooling efficiency and noise generating vibration damping rigidity are simultaneously rendered possible without incurring excessive weight penalties.

The solution of this object is achieved by the features of claim 1.

Brief Description of the Drawings

The features and advantages of the arrangement of the present invention will become more clearly appreciated from the following description taken in conjunction with the accompanying drawings in which:

Fig. 1 shows the prior art arrangement discussed briefly in the opening paragraphs of the present disclosure;

Fig. 2 is a schematic elevation (partially in section) showing a previously proposed engine cooling system in combination with which the present invention finds particular application;

Fig. 3 is a sectional view of a first embodiment of the present invention;

Fig. 4 is a sectional elevation of the arrangement shown in Fig. 3;

Fig. 5 is a sectional elevation showing a second embodiment of the present invention;

Figs. 6 and 7 are sectional views showing a third embodiment of the present invention;

Figs. 8 and 9 are sectional views of a fourth embodiment of the present invention; and

Fig. 10 is a sectional view of a fifth embodiment of the present invention.

Detailed Description of the Preferred Embodiments

Turning now to Figs. 3 and 4 a first embodiment of the present invention is shown. In this arrangement, web-like ribs 20 are formed between and integral the cylindrical cylinders 22 and the outer walls 24 of the cylinder block 26. As previously mentioned, the cylindrical nature of the cylinders 22 endows on same a relatively high rigidity which when connected with the outer walls 24 of the cylinder block 26 secures same against diaphram-linked inward and outward flexture. The disposition of the ribs 20 in diametrically arranged pairs also serves to increase the structural rigidity of the arrangement. As shown in Fig. 4, the ribs 20 in the first embodiment are arranged to extend continuously between the upper and lower decks 28, 30 of the cylinder block 26 endowing on same considerable resistance to the forces produced by the reciprocation of the pistons and associated rotation of the crank shaft, which tend to induce twisting and bending of the cylinder block per se. The upper deck 28 is formed with vent holes 32 through which the boiling coolant is discharge.

An advantage derived with this arrangement comes in that the cylinders are themselves reinforced against deformation by the ribs in a manner which facilitates the construction of long stroke or "under square" engines.

A further and some important feature of the present invention is that the ribs 20 serve to conduct heat away from the cylinders 22 and transmit same toward the outer walls 24. Accordingly, as the cylinder block 26 per se has a high heat accumulating capacity and the ribs 20 provide an increased surface area via which heat may be transmitted to the coolant, the cooling efficiency of the arrangement is notably increased.

Fig. 5 shows a second embodiment of the present invention. In this arrangement ribs 34 are arranged to terminate short of the upper (and/or lower) deck 28. With this arrangement good structural rigidity (with attendant weight reduction) of the cylinder block is obtained despite the reduced size of the ribs. The length and other dimensions of the ribs should be selected in view of the vibrational characteristics of the engine cylinder block to which the embodiment is applied.

Figs. 6 and 7 show a third embodiment of the present invention. In this arrangement additional ribbing or webs 36 are formed to extend essentially normally with respect to each of the main ribs 20. As will be appreciated, these additional ribs 36 function both as cooling fins and as reinforcing members. A notable increase in cyclinder block rigidity is provided by this arrangement.

Figs. 8 and 9 show a fourth embodiment of the present invention which comprises web-like ribs 38 which are provided at the level of the upper deck. This embodiment increases the rigidity of the cylinder block as compared to an arrangement wherein the upper deck is completely omitted without rendering die casting of the block difficult.

Fig. 10 shows a fifth embodiment of the present invention wherein four ribs 40 are provided per cylinder. These ribs are formed with tapped bores 42 which permit the head bolts used to secure the cylinder head to the block to be located closer than normal to the combustion chamber(s). This improves both the sealing between the head and the block and the rigidity with which the two members are secured together.

Claims

1. A cylinder block (26) for an internal combustion engine comprising:

an outer wall (24) comprising two side walls extending substantially parallel to the axis of the cylinder row and two end walls perpendicular thereto;

a lower deck (30);

a plurality of cylinders (22) arranged to receive pistons therein, said cylinders (22) being disposed within said outer wall (24) and to extend upwardly from said lower deck (30);

a plurality of reinforing ribs (20, 34, 40) which interconnect and are integral with one or more of said side and end walls forming the outer wall (24), said plurality of cylinders (22) and the lower deck (30), characterized in that said ribs (20, 34, 40) connect said side walls to said cylinders (22) and extend in the axial direction of said cylinders (22) from said lower deck (30) along more than half of the axial lengths of the cylinders (22) toward the tops thereof, the ribs dividing the space defined between the cylinders (22) and the outer wall (24) into compartments which define means into which liquid coolant can be introduced in liquid form, permitted to heat in the absence of forceful coolant circulation, boil and be discharged in gaseous form; in that a plurality of openings (32) is provided at the top of the cylinder block (26) through which the gaseous coolant generated in said compartments can be discharged into a cylinder head disposed on top of the cylinder block (26), and that the axial ribs comprise web-like ribs (36 or 38) extending essentially normally from each of said ribs (20).

2. A cylinder block as claimed in claim 1, characterized in that said web-like ribs (36) interconnect said cylinder (22) and said outer wall (24).

3. A cylinder block as claimed in claim 1, characterized in that the cylinder block further comprises an upper deck (28).

4. A cylinder block as claimed in claim 3, characterized in that said ribs (20) extend from the lower deck (30) to the upper one (28) and are integral therewith.

5. A cylinder block as claimed in claim 3, characterized in that said ribs (34) extending from said lower deck (30) toward the upper one (28), are integrally formed with the lower deck (30) but

terminate short of the upper deck (28).

6. A cylinder block as claimed in claim 1, characterized in that said cylinder block (26) has no upper deck and the ribs (20) extend from the lower deck (30) to the top of the cylinder block (26).

7. A cylinder block as claimed in claim 6, characterized in that said web-like ribs (38) are formed at the tops thereof at the level an upper deck (28) would be if provided.

Patentansprüche

1. Zylinderblock (26) für eine Brennkraftmaschine, mit:

einer Außenwandung (24) mit zwei Seitenwänden, die sich im wesentlichen parallel zur Achse der Zylinderreihenanordnung erstrecken und zwei Endwänden rechtwicklig hierzu,

einem unteren Boden (30),

einer Mehrazahl von Zylindern (22), die vorgesehen sind, um Kolben in sich aufzunehmen, wobei die Zylinder (22) innerhalb der Außenwandung (24) angeordnet sind und sich von dem unteren Boden (30) aus nach oben erstrecken,

einer Mehrzahl von Verstärkungsrippen (20, 34, 40), die integral einstückig mit einer oder meheren der Seiten- und Endwände sind, die die Außenwandung (24), die Mehrzahl Zylinder (22) und den unteren Boden (30) bilden und miteinander verbinden, dadurch gekennzeichnet, daß die Rippen (20, 30, 40) die Seitenwände mit den Zylindern (22) verbinden und sich in axialer Richtung der Zylinder (22) von dem unteren Boden (30) über mehr als die Hälfte der axialen Länge der Zylinder (22) in Richtung der oberen Enden der Zylinder erstrecken, die Rippen den Raum, der zwischen den Zylindern (22) und der Außenwandung (24) begrenzt ist, in Abteilungen unterteilen, die eine Einrichtung bilden, in die flüssiges Kühlmittel in flüssiger Form eingefüllt werden kann, in denen es sich erwärmen und in Abwesenheit einer Kühlmittelwangszirkulation sieden kann und aus denen es in gasförmiger Form abgeführt werden kann, daß eine Merhrzahl von öffnungen (32) an der Oberseite des Zylinderblockes (26) vorgesehen ist, durch die das gasförmige Kühlmittel, das in den Abteilungen erzeugt wurde, in einen Zylinderkopf abgegeben werden kann, der an der Oberseite des Zylinderblocks (26) vorgesehen ist, und daß die axialen Rippen bandförmige Rippen (36 oder 38) aufweisen, die sich im wesentlichen senkrecht von jeder Rippen (20) aus erstrecken.

2. Zylinderblock nach Anspruch 1, dadurch gekennzeichnet, daß die bandförmigen Rippen (36) den Zylinder (22) mit der Außenwandung (24) verbinden.

3. Zylinderblock nach Anspruch 1, dadurch gekennzeichnet, daß der Zylinderblock außerdem eine obere Deckplatte (28) aufweist.

4. Zylinderblock nach Anspruch 3, dadurch gekennzeichnet, daß sich die Rippen (20) von dem unteren Boden (30) zu der oberen Deckplatte (28) erstrecken und mit diesem integral einstückig ausgeführt sind.

5. Zylinderblock nach Anspruch 3, dadurch gekennzeichnet, daß sich die Rippen (34) vom unteren Boden (30) in Richtung der oberen Deckplatte (28) erstrecken und integral einstückig mit dem unteren Boden (30) ausgebildet sind, jedoch kurz vor der oberen Deckplatte (28) enden.

6. Zylinderblock nach Anspruch 1, dadurch gekennzeichnet, daß der Zylinderblock (26) keine obere Deckplatte aufweist und die Rippen (20) sich vom unteren Boden (30) bis zur Oberseite des Zylinderblockes (26) erstrecken.

7. Zylinderblock nach Anspruch 6, dadurch gekennzeichnet, daß die bandförmigen Rippen (38) an den oberen Enden auf dem Niveau ausgebildet sind, auf dem eine obere Deckplatte (28) vorgesehen wäre.

Revendications

1. Bloc-cylindres (26) pour moteur à combustion interne comprenant:

une paroi externe (24) comprenant deux parois latérales s'étendant sensiblement parallèlement à l'axe de la rangée des cylindres et deux parois d'extrémité perpendiculaires à celui-ci;

une plaque de fond (30);

une pluralité de cylindres (22) disposés pour recevoir des pistons, lesdits cylindres (22) étant disposés à l'intérieur de ladite paroi externe (24), et pour s'étendre vers le haut depuis ladite plaque de fond (30);

une pluralité de nervures de renforcement (20, 34, 40) qui relient et sont de matière avec une ou plusieurs desdites parois latérales et d'extrémité formant la paroi externe (24), ladite pluralité de cylindres (22) et la plaque de fond (30), caractérisé en ce que lesdites nervures (20, 34, 40) relient lesdites parois latérales auxdits cylindres (22) et s'étendent en direction axiale desdits cylindres (22) depuis ladite plaque de fond (30) sur plas de la moitié des longueurs axiales des cylindres (22) en direction de leurs sommets, les nervures divisant l'espace défini entre les cylindres (22) et la paroi externe (24) en compartiments qui définissent des moyens dans lesquels un fluide caloporteur liquide peut être introduit sous forme liquide, peut être chauffé en l'absence de circulation forcée du fluide caloporteur, peut bouillir et être évacué sous forme gazeuse; en ce qu'une pluralité d'ouvertures (32) est prévue au sommet du bloc-cylindres (26) par lesquelles le fluide caloporteur gazeux produit dans lesdits compartiments peut être évacué dans une culasse disposée au sommet du bloc-cylindres (26), et en ce que les nervures axiales comprennent des nervures en lame (36 ou 38) qui s'étendent essentiellement perpendiculairement à partir de chacune desdites nervures (20).

2. Bloc-cylindres selon la revendication 1, caractérisé en ce que lesdites nervures en lame (36) relient ledit cylindre (22) et ladite paroi externe (24).

3. Bloc-cylindres selon la revendication 1, caractérisé en ce que le bloc-cylindres comprend

en outre une plaque de sommet (28).

4. Bloc-cylindres selon la revendication 3, caractérisé en ce que lesdites nervures (20) s'étendent depuis la plaque de fond (30) jusqu'à la plaque de sommet (28) et sont de matière avec celles-ci.

5. Bloc-cylindres selon la revendication 3, caractérisé en ce que lesdites nervures (34) qui s'étendent depuis lesdite plaque de fond (30) en direction de la plaque de sommet (28), sont de matière avec la plaque de fond (30) mais se terminent au-dessous de la plaque de sommet (28).

6. Bloc-cylindres selon la revendication 1, caractérisé en ce que ledit bloc-cylindres (26) n'a pas de plaque de sommet et en ce que nervures (20) s'étendent depuis la plaque de fond (30) jusqu'au sommet du bloc-cylindres (26).

7. Bloc-cylindres selon la revendication 6, caractérisé en ce que lesdites nervures en lame (38) sont formées à leurs sommets au niveau auquel se trouverait une plaque de sommet (28) si elle était prévue.

FIG.1
(PRIOR ART)

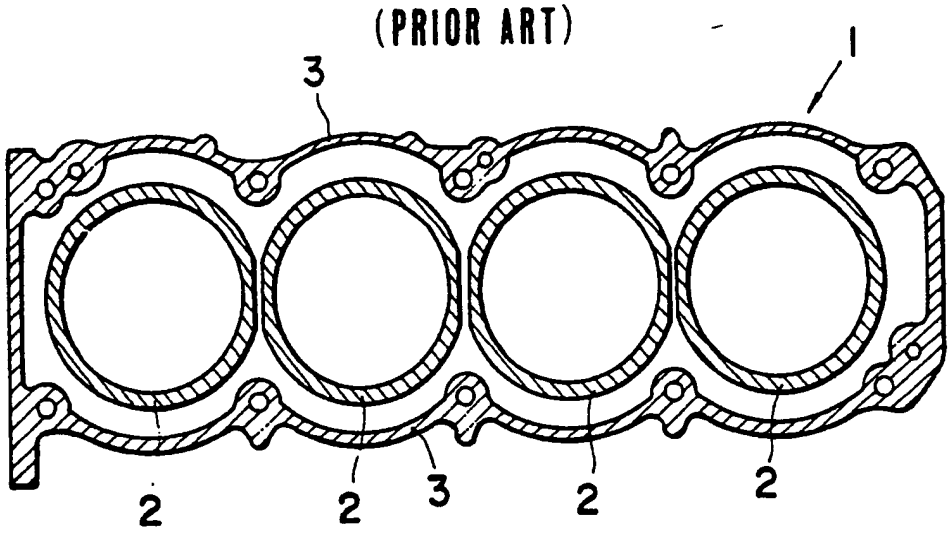
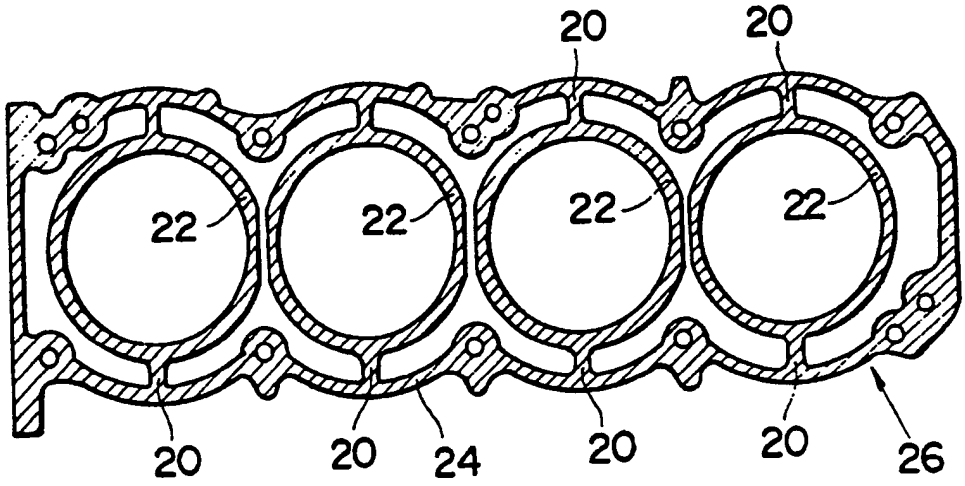


FIG.3



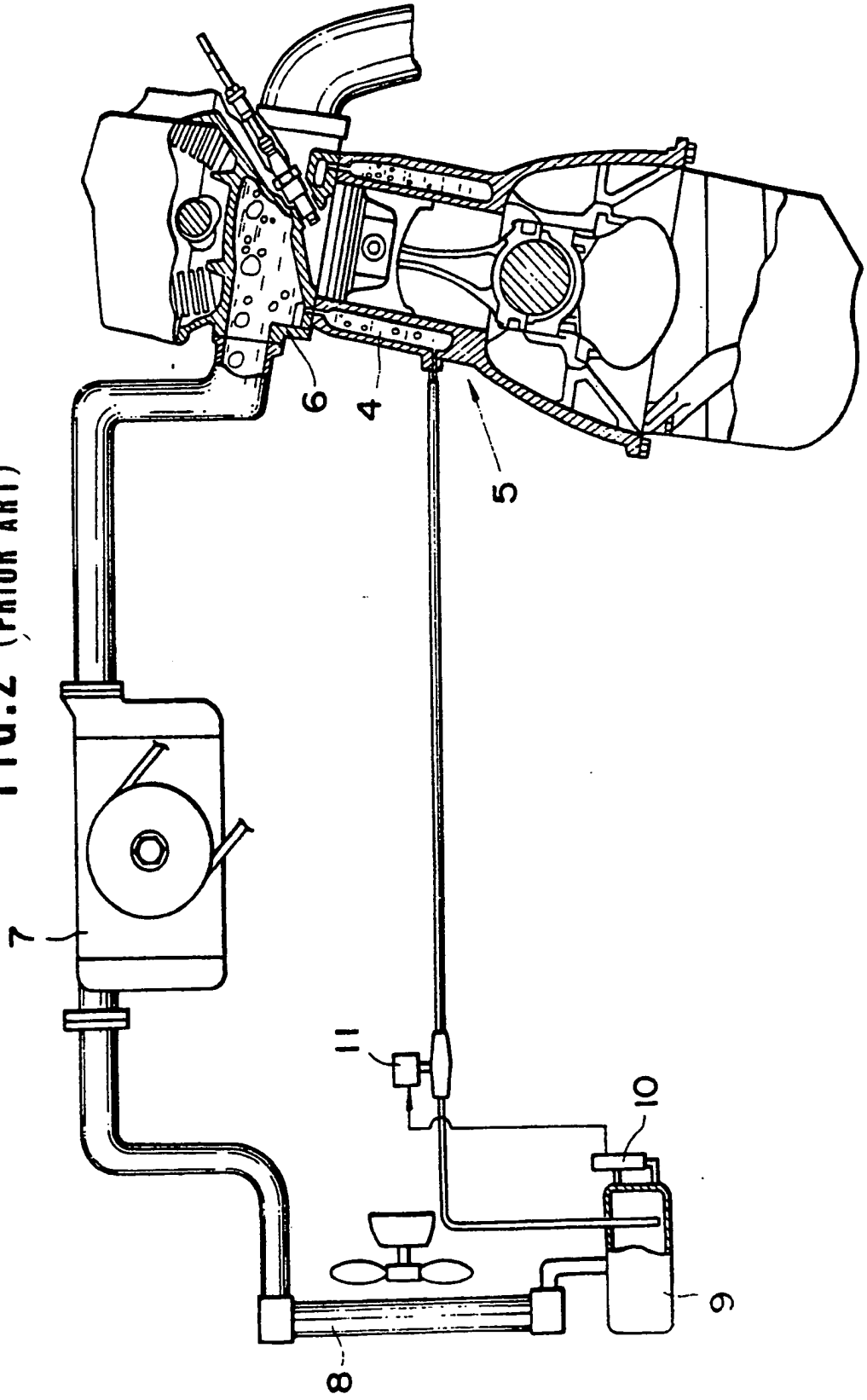


FIG.2 (PRIOR ART)

FIG.4

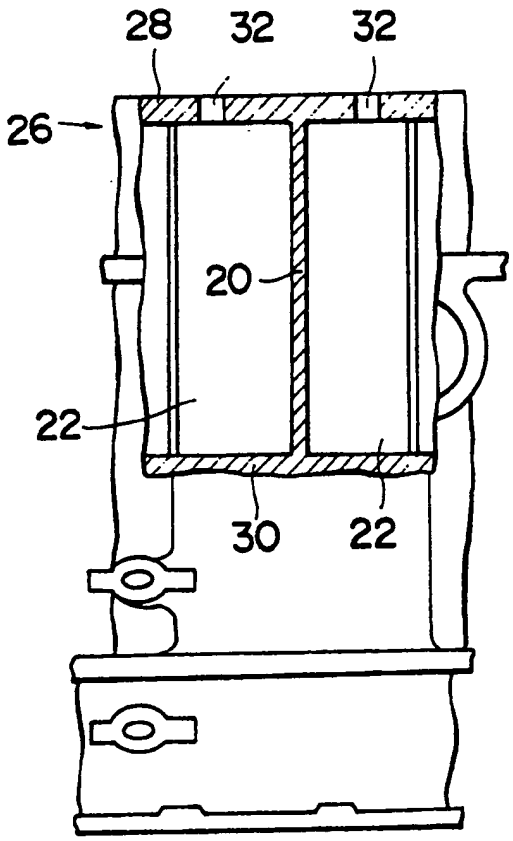


FIG.5

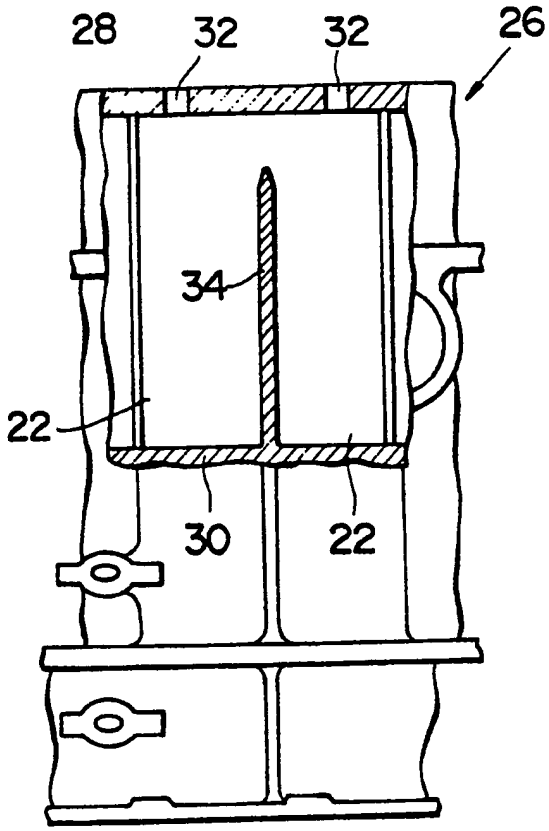


FIG.6

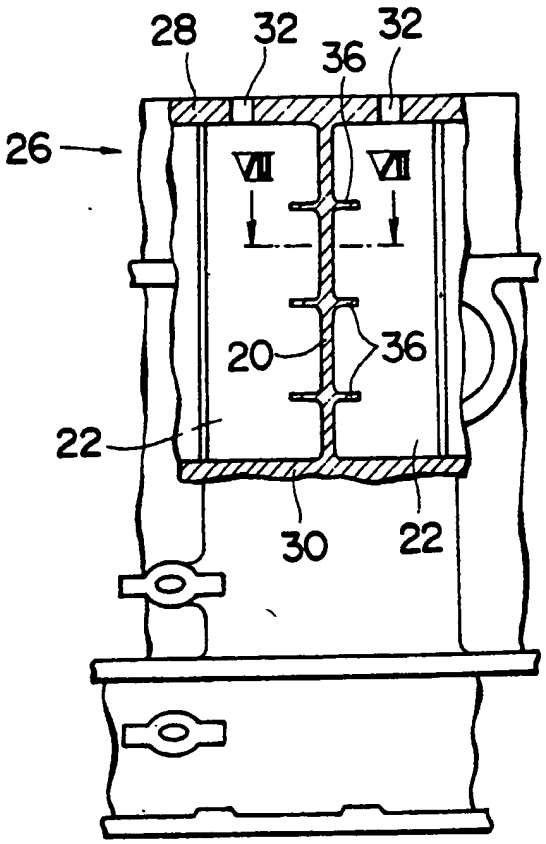


FIG.7

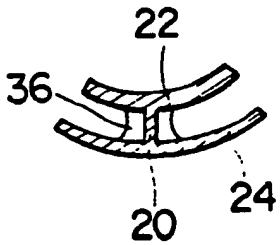


FIG.8

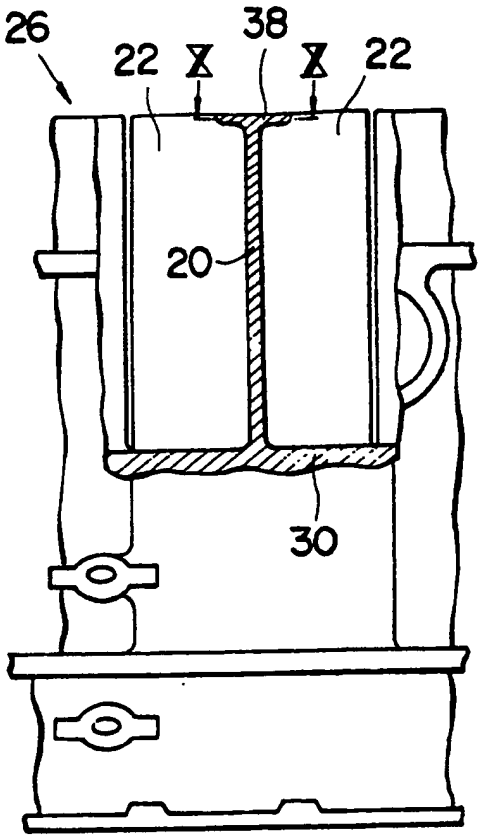


FIG.9

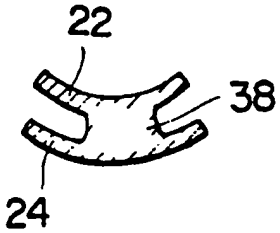


FIG.10